

REMARKS

Reconsideration and allowance of the above-identified application, as currently amended, is respectfully requested.

By the present amendments, claims 4-14 and 21-24 are pending of which independent claims 4 and 14 were amended and claims 22-24 were newly presented. The revisions made to independent claims 4 and 14 further highlight the structurally characterizing aspects of the invention including in terms of more particularly highlighting the relative positioning of the closed flow passage within which the operating fluid is hermetically enclosed such that it is formed between a surface side of the plate-like semiconductor layer opposite that on which the circuits are formed and a surface side of the heat transfer layer which is facing in a direction oppositely thereto. This is also the case with regard to the driving means of the operating fluid. From Figs. 1, 4 and 5(A), for example, the heat transfer layer is formed on the surface side of the chip opposite the side of the chip on which the circuit forming layer is formed and that the heat transfer layer is connected with the plate-like semiconductor chip in one body and, moreover:

The heat transfer layer forms between said another, opposing surface side of the plate-like semiconductor layer and one surface side of said heat transfer layer facing in an opposite direction thereto:

a closed flow passage;

an operating fluid hermetically enclosed within said closed flow passage; and

driving means of said operating fluid....

Such featured aspects are specifically called for in independent claims 4 and 14. Examples of such are given in Figs. 4 and 5(A)-5(B) and also with regard to Fig. 1 of the drawings.

Regarding the example embodiment shown in Figs. 4 and 5 of the drawings, a localized rise in temperature in the electric circuit forming layer (e.g., 2) is suppressed by the heat transfer action of the hermetically enclosed fluid (e.g., 4 which may be water) in the passage ducts (e.g., 3). The passage ducts are driven by the driving means which is made of electrically operated means for giving vibration to the hermetically enclosed operating fluid (e.g., resistor layer such as 5 in Figs. 4-7 or 12 in Fig. 1), which is positioned outside the closed flow passage of the operating fluid, which enables formation of bubbles in the operating fluid. As can be seen from the drawings, the heat transfer layer forms the closed flow passage within which the fluid is hermetically enclosed between a surface side of the semiconductor chip opposite the side of the chip on which the circuits are formed and a surface side of the heat transfer layer which is facing in an opposite direction thereto. In Fig. 1, for example, the closed flow passage 3 of the heat transfer layer 15 is formed on a side of the heat transfer layer 15 which faces in a direction opposite that of the surface side of the chip which is opposite the side of the chip on which the circuit forming layer 2 is located. This is also consistent with the showings in Figs. 4 and 5 of the drawings, although not to be construed as being limited thereto. Discussion of the example embodiment shown in Figs. 4-5 is given from page 10, line 29 to page 13, line 9, in description regarding the transferring (diffusing) function of the heat generation in the integrated circuit, which is at it relates to the example Figs. 1 and 5 embodiments is given on page 15, line 26, of the Substitute Specification.

Such featured aspects are also contained with regard to newly presented independent claims 22 and 23. Independent claims 22 and 23, however,

do not feature the structural particulars concerning the set forth driving means. It is submitted, the invention accorded to claims 4-14 and 21-24 is patentable over the art as applied in the outstanding rejection.

In the office action, claims 4-9, 11, 12, 14 and 21 were rejected under 35 U.S.C. §103(a), allegedly, as being obvious over Zuo (USP 6,631,077) in view of *Microchip Fabrication* by Peter Van Zant and Ohashi et al (JP 07-286788); and claims 10 and 13 were rejected under 35 U.S.C. §103(a), allegedly, as being obvious over the same combination of Zuo in view of *Microchip Fabrication* by Peter Van Zant and Ohashi et al and further in view of O'Connor et al (US 2002/00392800). As is shown below, the invention according to these claims and, likewise, with regard to the newly added claims 22-24, could not have been achieved in view of the combined teachings of these references and as alleged in the outstanding rejection. Therefore, insofar as presently applicable, these rejections are traversed and withdrawal of the same is respectfully requested. According to each of the independent claims 4, 14, 22 and 24, a key aspect thereof is the relative positioning of the closed flow passage within which fluid is hermetically enclosed. As highlighted earlier in these Remarks, among the set forth aspects according to independent claim 4, the semiconductor integrated circuit chip which is formed as a plate-like semiconductor chip, calls for:

a circuit forming layer, on which a plurality of circuits are formed, being formed on one surface side of the plate-like semiconductor chip; and

a heat transfer layer, connected with the plate-like semiconductor chip in one body, being formed on another, opposing surface side of the plate-like semiconductor chip, and which forms between said another, opposing surface side of the plate-like semiconductor chip and one surface side of said heat transfer layer opposing thereto:

a closed flow passage;

an operating fluid hermetically enclosed within said closed flow passage; and

As is apparent from such a schemed construction, the closed flow passage within which the fluid is hermetically enclosed is formed between the surface side of the semiconductor chip, opposite the side thereof on which the circuits are formed, and the surface side of the heat transfer layer facing in an opposite direction thereto. It is submitted, a schemed construction as that presently set forth in independent claim 4 and, likewise, in the dependent claims thereof, was not taught even in view of the combined teachings of the applied references.

Zuo discloses a PCB assembly (e.g., 100 in Fig. 1 and 700 in Fig. 7).

Regarding the heat spreader in Fig. 1 in Zuo, 130 provokes movement of the fluid 122 between opposing ends 112 and 113 of the base plate 111 by the channels 120 (column 3, lines 15-30, in Zuo). According to Zuo's schemed assembly of the component elements, such as shown in Fig. 1 of the drawings, it is observed that the heat spreader 110 is formed separately from the IC 160.

Whereas according to the invention, the heat transfer layer is connected with the plate-like semiconductor chip in one body and forms a closed flow passage within which fluid is hermetically enclosed between a surface side of the chip opposite a side thereof on which a circuit forming layer is provided and a side of the heat transfer layer opposing thereto, in clear contradistinction with that taught by Zuo. Applicants also consider the invention according to independent claim 14 and the corresponding dependent claim 21, as well as that of add independent claims 22 and 23 patentable over the teachings of Zuo for the same and similar reasons of that discussed above.

Van Zant discusses different types of circuit categories, such as logic circuits, memory circuits, and also discusses the microprocessor. However, notwithstanding Van Zant's teachings, Van Zant, Applicants submits, does not overcome the deficiency of Zuo's teachings. Nor, for that matter, even if Zuo and Van Zant are considered in combination. This, even if Ohashi et al is applied in combination with Zuo and Van Zant. Ohashi et al was applied in the rejection for its alleged teaching of modifying the semiconductor device of Zuo to include "the use of a driving means of operating fluid...made of electrically operated means...". Notwithstanding Ohashi et al's teaching, the above-noted deficiencies of Zuo still would not have been overcome even if Zuo were to have been combined with Van Zant and Ohashi et al.

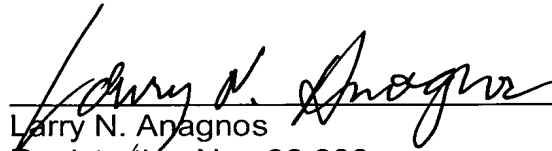
O'Connor et al was applied for its alleged teaching of employing a temperature detection means according to that set forth in claims 10 and 13. Notwithstanding O'Connor et al's alleged teachings, O'Connor also failed to disclose or suggest a schemed chip construction with a cooling scheme as that presently set forth. Even if one of ordinary skill would have considered the combined teachings of Zuo, Van Zant, Ohashi et al and O'Connor et al, the invention of independent claims 4, 14, 22 and 23 and likewise that of the corresponding dependent claims thereof still could not have been achievable, for at least the above-noted reasons.

Therefore, in view of the above-made amendments together with these accompanying Remarks, withdrawal of the outstanding rejection, as well as favorable action on the pending claims, i.e., claims 4-14 and 21-24 is respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (Case No. 520.43306X00) and please credit any excess fees to such deposit account.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read "Larry N. Anagnos", is written over a horizontal line.

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Attachments
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